IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.:	10/802,428	§	Confirmation No.:	3515
Applicant:	Bin Zhang	§		
Filed:	03/17/2004	§		
TC/A.U.:	2621	§		
Examiner:	David N. Werner	§		
Title:	ESTIMATING MOTION TRIALS IN VIDEO IMAGE SEQUENCES	§ § §		
Docket No.:	200314385-1 (HPC.0783US)	§ §		

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
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APPEAL BRIEF PURSUANT TO 37 C.F.R § 41.37

Sir:

The final rejection of claims 1-3, 5, 7-17, 19-25 and 27 is hereby appealed.

I. REAL PARTY IN INTEREST

The real party in interest is the Hewlett-Packard Development Company, LP. The Hewlett-Packard Development Company, LP, a limited partnership established under the laws of the State of Texas and having a principal place of business at 11445 Compaq Center Drive West, Houston, TX 77070, U.S.A. (hereinafter "HPDC"). HPDC is a Texas limited partnership and is a wholly-owned affiliate of Hewlett-Packard Company, a Delaware Corporation, headquartered in Palo Alto, CA. The general or managing partner of HPDC is HPQ Holdings, LLC.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF THE CLAIMS

Claims 1-3, 5, 7-15, 17, 19-25 and 27 have been finally rejected and are the subject of this appeal. Claims 4, 6, 16, 18, 26 and 28-29 have been cancelled.

IV. STATUS OF AMENDMENTS

No amendment after the final rejection of August 20, 2009 has been submitted. Therefore, all amendments have been entered.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The following provides a concise explanation of the subject matter defined in each of the independent claims involved in the appeal, referring to the specification by page and line number and to the drawings by reference characters, as required by 37 C.F.R. § 41.37(c)(1)(v). Each element of the claims is identified by a corresponding reference to the specification and drawings where applicable. Note that the citation to passages in the specification and drawings for each claim element does not imply that the limitations from the specification and drawings should be read into the corresponding claim element.

Independent claim 1 recites an article of manufacture, comprising:

a program storage device (Fig. 5:588, 530) having stored thereon program instructions executable by a processing device to perform operations for estimating motion trials in video image sequences, the operations (Spec., p. 18, ¶ [0088], ln. 1-7; p. 9, ¶ [0029], ln. 1-4) comprising:

providing (Fig. 9:940) data points representing information from an image sequence (Spec., p. 13, ¶ [0057], ln. 1-3; p. 18, ¶ [0084], ln. 4-7); and

performing regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points (Spec., p. 14, ¶ [0062], ln. 1 - ¶ [0064], ln. 6);

wherein the performing regression clustering includes:

selecting (Fig. 8:810) a number, K, of regression clusters for data points from an image sequence (Spec., p. 17, ¶ [0083], ln. 3-5);

initializing (Fig. 8:820) regression functions for each of the K clusters to estimate centers of motion for the data points (Spec., p. 17, ¶ [0083], ln. 5-6);

calculating (Fig. 8:830) distances from each data point to each of the K regression functions (Spec., p. 15, ¶ [0068], ln. 1; p. 17, ¶ [0083], ln. 7);

calculating (Fig. 8:840) a membership probability (Spec., p. 15, ¶ [0069], ln. 1 - ¶ [0070], ln. 1) for each data point based on distances between the K regression functions and each data point (Spec., p. 17, ¶ [0083], ln. 7-8);

applying (Fig. 8:850) regression to recalculate the K regression functions based at least on the membership probabilities (Spec., p. 17, ¶ [0083], ln. 9-10);

determining (Fig. 8:860) whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion (Spec., p. 16, ¶ [0076], ln. 1-3; p. 17, ¶ [0083], ln. 10-12);

repeating (Fig. 8:830, 840, 850, 860) calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion (Spec., p. 17, ¶ [0083], ln. 12-16); and

using (Fig. 10:1030) motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion (Spec., p. 18, ¶ [0085], ln. 1 - ¶ [0087], ln. 4).

Independent claim 13 recites a system (Fig. 6:600) for estimating motion trials in video image sequences, comprising:

an image sequence retrieval module (Fig. 6:608) for retrieving a current image and a first reference image and providing data points representing information from the current image and the first reference image (Spec., p. 11, ¶ [0037], ln. 4-6; p. 9, ¶ [0031], ln. 2-6; p. 13, ¶ [0057], ln. 1-3; p. 18, ¶ [0084], ln. 4-7); and

a motion estimator (Fig. 6:610), coupled to the image sequence retrieval module, for performing regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points (Spec., p. 11, ¶ [0038], ln. 1-5; p. 14, ¶ [0062], ln. 1 - ¶ [0064], ln. 6);

wherein the motion estimator performs regression clustering by selecting (Fig. 8:810) a number, K, of regression clusters for data points from an image sequence (Spec., p. 17, ¶ [0083], ln. 3-5), initializing (Fig. 8:820) regression functions for each of the K clusters to estimate centers of motion for the data points (Spec., p. 17, ¶ [0083], ln. 5-6), calculating (Fig. 8:830) distances from each data point to each of the K regression functions (Spec., p. 15, ¶ [0068], ln. 1; p. 17, ¶ [0083], ln. 7), calculating (Fig. 8:840) a membership probability (Spec., p. 15, ¶ [0069], ln. 1 - ¶ [0070], ln. 1) for each data point based on distances between the K regression functions and each data point (Spec., p. 17, ¶ [0083], ln. 7-8), applying (Fig. 8:850) regression to recalculate the K regression functions based at least on the membership probabilities (Spec., p. 17, ¶ [0083], ln. 9-10), determining (Fig. 8:860) whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion (Spec., p. 16, ¶ [0076], ln. 1-3; p. 17, ¶ [0083], ln. 10-12), repeating (Fig. 8:830, 840, 850, 860) calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion (Spec., p. 17, ¶ [0083], ln. 12-16), and using (Fig. 10:1030) motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion (Spec., p. 18, ¶ [0085], ln. 1 - ¶ [0087], ln. 4).

Independent claim 25 recites a method for estimating motion trials in video image sequences, the method comprising:

providing (Fig. 9:940) data points representing information from an image sequence(Spec., p. 13, ¶ [0057], ln. 1-3; p. 18, ¶ [0084], ln. 4-7); and

performing, by a processor, regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points (Spec., p. 14, ¶ [0062], ln. 1 - ¶ [0064], ln. 6),

wherein the performing regression clustering comprises:

selecting (Fig. 8:810) a number, K, of regression clusters for data points from an image sequence (Spec., p. 17, ¶ [0083], ln. 3-5);

initializing (Fig. 8:820) regression functions for each of the K clusters to estimate centers of motion for the data points (Spec., p. 17, ¶ [0083], ln. 5-6);

calculating (Fig. 8:830) distances from each data point to each of the K regression functions (Spec., p. 15, ¶ [0068], ln. 1; p. 17, ¶ [0083], ln. 7);

calculating (Fig. 8:840) a membership probability (Spec., p. 15, ¶ [0069], ln. 1 - ¶ [0070], ln. 1) for each data point based on distances between the K regression functions and each data point(Spec., p. 17, ¶ [0083], ln. 7-8);

applying (Fig. 8:850) regression to recalculate the K regression functions based at least on the membership probabilities(Spec., p. 17, ¶ [0083], ln. 9-10);

determining (Fig. 8:860) whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion(Spec., p. 16, ¶ [0076], ln. 1-3; p. 17, ¶ [0083], ln. 10-12);

repeating (Fig. 8:830, 840, 850, 860) calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion (Spec., p. 17, ¶ [0083], ln. 12-16); and

using (Fig. 10:1030) motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion(Spec., p. 18, ¶ [0085], ln. 1 - ¶ [0087], ln. 4).

Claim 27, set forth below, includes means plus function elements, which are identified as required by 37 C.F.R. § 41.37. For each means plus function element, the structure, material, or acts described in the Specification as corresponding to each claimed function is set forth by reference to page and line number, and to the drawings, by reference characters.

Independent claim 27 recites a system (Fig. 6:600) for estimating motion trials in video image sequences, comprising:

means (Fig. 6:608) for retrieving a current image and a first reference image and providing data points representing information from the current image and the first reference image (Spec., p. 11, ¶ [0037], ln. 4-6; p. 9, ¶ [0031], ln. 2-6; p. 13, ¶ [0057], ln. 1-3; p. 18, ¶ [0084], ln. 4-7); and

means (Fig. 6:610) for performing regression clustering, coupled to the means for retrieving and providing, wherein the means for performing regression clustering uses a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points (Spec., p. 11, ¶ [0038], ln. 1-5; p. 14, ¶ [0062], ln. 1 - ¶ [0064], ln. 6),

wherein the means for performing regression clustering further comprises means for selecting (Fig. 8:810) a number, K, of regression clusters for data points from an image sequence(Spec., p. 17, ¶ [0083], ln. 3-5), means for initializing (Fig. 8:820) regression functions for each of the K clusters to estimate centers of motion for the data points(Spec., p. 17, ¶ [0083], ln. 5-6), means for calculating (Fig. 8:830) distances from each data point to each of the K regression functions(Spec., p. 15, ¶ [0068], ln. 1; p. 17, ¶ [0083], ln. 7), means for calculating (Fig. 8:840) a membership probability (Spec., p. 15, ¶ [0069], ln. 1 - ¶ [0070], ln. 1) for each data point based on distances between the K regression functions and each data point(Spec., p. 17, ¶ [0083], ln. 7-8), means for applying (Fig. 8:850) regression to recalculate the K regression functions based at least on the membership probabilities (Spec., p. 17, ¶ [0083], ln. 9-10), determining (Fig. 8:860) whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion(Spec., p. 16, ¶ [0076], ln. 1-3; p. 17, ¶ [0083], ln. 10-12), repeating (Fig. 8:830, 840, 850, 860) calculating the distances, calculating the membership probability, applying regression, and determining whether the changes satisfy the stopping criterion if tasks of the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion (Spec., p. 17, ¶ [0083], ln. 12-16), and means for using (Fig. 10:1030) motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion (Spec., p. 18, ¶ [0085], ln. 1 - ¶ [0087], ln. 4).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Claims 1-3, 5, 7, 10-15, 17, 19, and 22-25 were rejected under 35 U.S.C. § 103(a) as unpatentable over "Motion-based Segmentation Using a Thresholded Merging Strategy on Watershed Segments" (de Smet) in view of "K-Harmonic Means-A Data Clustering Algorithm" (Zhang).

B. Claims 8, 9, 20, and 21 were rejected under 35 U.S.C. § 103(a) as unpatentable over de Smet in view of Zhang and further in view of "A Video Segmentation Algorithm for Hierarchical Object Representations and its Implementation" (Herrmann).

C. Claim 27 was rejected under 35 U.S.C. § 103(a) as unpatentable over de Smet in view of Zhang and further in view of U.S. Patent No. 6,084,912 (Reitmeier).

VII. ARGUMENT

The claims do not stand or fall together. Instead, Appellant presents separate arguments for various independent and dependent claims. Each of these arguments is separately argued below and presented with separate headings and sub-headings as required by 37 C.F.R. § 41.37(c)(1)(vii).

A. Claims 1-3, 5, 7, 10-15, 17, 19, and 22-25 were rejected under 35 U.S.C. § 103(a) as unpatentable over "Motion-based Segmentation Using a Thresholded Merging Strategy on Watershed Segments" (de Smet) in view of "K-Harmonic Means-A Data Clustering Algorithm" (Zhang).

1. Claims 1-3, 7, 10-12, 25.

It is respectfully submitted that claim 1 is non-obvious over de Smet and Zhang.

To make a determination under 35 U.S.C. § 103, several basic factual inquiries must be performed, including determining the scope and content of the prior art, and ascertaining the differences between the prior art and the claims at issue. *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 U.S.P.Q. 459 (1965). Moreover, as held by the U.S. Supreme Court, it is important to identify a reason that would have prompted a person of ordinary skill in the art to combine

reference teachings in the manner that the claimed invention does. *KSR International Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1741, 82 U.S.P.Q.2d 1385 (2007).

The Examiner conceded that de Smet, the primary reference, fails to disclose performing regression clustering using a K-Harmonic Means function in the manner recited in claim 1. 08/20/2009 Office Action at 5. Instead, the Examiner cited Zhang as purportedly disclosing the claimed subject matter. *Id.* at 6.

There are several differences between the K-Harmonic Means clustering algorithm described in Zhang and the K-Harmonic Means clustering recited in claim 1.

First, the Examiner erred in arguing that the parameter $q_{i,k}$ in Eq. 7 of Zhang constitutes a membership probability as recited in claim 1. Based on Eq. 7 of Zhang, it appears that $q_{i,k}$ is equal to $d_{i,min}$ (multiplied by a unitless number) divided by $\left[1+\sum\left(\frac{d_{i,\min}}{d_{i,l}}\right)^2\right]^2$, where $\left[1+\sum\left(\frac{d_{i,\min}}{d_{i,l}}\right)^2\right]^2$ is also basically a unitless number. Note that $\left(\frac{d_{i,\min}}{d_{i,k}}\right)^3$ in the numerator of Eq. 7 produces a unitless number that is multipled by $d_{i,min}$.

Since $q_{i,k}$ represents a distance value, expressed by $d_{i,min}$ multipled by a unitless number and divided by a unitless number, it would be unreasonable to assert that $q_{i,k}$ represents a membership **probability**. A person of ordinary skill in the art would clearly understand that a distance is **not** a probability (or more specifically, a membership probability as recited in the claim).

In view of the foregoing, it is clear that even if de Smet and Zhang could be hypothetically combined, the hypothetical combination of the references would not have led to at least the following claim elements:

- calculating a **membership probability** for each data point based on distances between the K regression functions and each data point;
- applying regression to recalculate the K regression functions based at least on the **membership probabilities**;
- determining whether changes in **membership probabilities** or changes in the K regression functions satisfy a stopping criterion;
- repeating calculating the distances, calculating the **membership probability**, applying regression, and determining whether changes satisfy the stopping criterion if the changes in **membership probabilities** or changes in the K regression functions do not satisfy the stopping criterion; and
- using motion paths represented by the K regression functions if the changes in **membership probabilities** or changes in the K regression functions satisfy the stopping criterion.

Moreover, note that the distances $d_{i,l}$ calculated on page 5 of Zhang are Euclidean distances between data points—in other words, each distance $d_{i,l}$ is between data point x_i and m_l. In contrast, claim 1 recites calculating distances from each data point to each of the K regression functions.

The Examiner argued that m_l as calculated by Eq. 5 on page 5 of Zhang constitutes the regression functions recited in claim 1. Eq. 5 on page 5 of Zhang merely calculates a data point m_l that takes the ratio of two distance values each formed by summing based on various distances, with the ratio then applied to the data point x_i. In other words, the data point m_l is equal to a scaled version of x_i according to Eq. 5. The data point m_l as calculated by Eq. 5 thus cannot properly be considered a regression function as recited in claim 1.

Therefore, even if de Smet and Zhang could be hypothetically combined, the hypothetical combination of references would not have led to the claimed subject matter.

Moreover, in view of the significant differences between the claimed subject matter and the teachings of de Smet and Zhang, it is respectfully submitted that a person of ordinary skill in the art would not have been prompted to combine the teachings of the references to achieve the claimed subject matter.

The obviousness rejection of claim 1 and its dependent claims is therefore erroneous.

Independent claim 25 is allowable over de Smet and Zhang for similar reasons.

Reversal of the final rejection of the above claims is respectfully requested.

2. Claim 5.

Claim 5 depends from base claim 1 and is allowable for at least the same reasons as claim 1. Moreover, claim 5 further recites **randomly** initializing **regression functions** for each of the K clusters. Although page 11 of Zhang refers to random initialization for the algorithms, there is no teaching or hint in this page of Zhang or anywhere else in Zhang of randomly initializing **regression functions** for each of the K clusters.

Claim 5 is therefore further allowable for the foregoing reason.

Reversal of the final rejection of the above claim is respectfully requested.

3. Claims 13-15, 19, 22-24.

Independent claim 13 is allowable over de Smet and Zhang for similar reasons as claim 1. Specifically, de Smet and Zhang fail to disclose or hint at a motion estimator for performing regression clustering using a K-Harmonic Means function, in the manner recited in the "wherein" clause of claim 13.

Claim 13 and its dependent claims are therefore non-obvious over de Smet and Zhang.

Reversal of the final rejection of the above claims is respectfully requested.

4. Claim 17.

Claim 17 depends from claim 13, and is therefore allowable for at least the same reasons as claim 13. Moreover, claim 17 is further allowable for the reasons stated above with respect to claim 5.

Reversal of the final rejection of the above claim is respectfully requested.

B. Claims 8, 9, 20, and 21 were rejected under 35 U.S.C. § 103(a) as unpatentable over de Smet in view of Zhang and further in view of "A Video Segmentation Algorithm for Hierarchical Object Representations and its Implementation" (Herrmann).

1. Claims 8, 9, 20, 21.

In view of the allowability of base claims over de Smet and Zhang, the obviousness rejection of dependent claims over de Smet, Zhang, and Herrmann has been overcome.

Reversal of the final rejection of the above claims is respectfully requested.

C. Claim 27 was rejected under 35 U.S.C. § 103(a) as unpatentable over de Smet in view of Zhang and further in view of U.S. Patent No. 6,084,912 (Reitmeier).

1. Claim 27.

In the rejection of independent claim 27, Reitmeier was cited as purportedly disclosing a "video encoder." This was argued by the Examiner as disclosing a general-purpose computer. 08/20/2009 Office Action at 9-10. With respect to the remaining elements of claim 27, the Examiner relied upon de Smet and Zhang. For similar reasons as discussed above in connection with claim 1, de Smet and Zhang clearly fail to disclose or hint at the combination of elements recited in claim 27.

Therefore, claim 27 is non-obvious over de Smet, Zhang, and Reitmeir.

Reversal of the final rejection of the above claim is respectfully requested.

CONCLUSION

In view of the foregoing, reversal of all final rejections and allowance of all pending claims is respectfully requested.

Respectfully submitted,

Date: January 19, 2010

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VIII. APPENDIX OF APPEALED CLAIMS

The claims on appeal are (Claims 4, 6, 16, 18, 26 and 28-29 have been cancelled):

1. An article of manufacture, comprising:

a program storage device having stored thereon program instructions executable by a processing device to perform operations for estimating motion trials in video image sequences, the operations comprising:

providing data points representing information from an image sequence; and

performing regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points;

wherein the performing regression clustering includes:

selecting a number, K, of regression clusters for data points from an image sequence;

initializing regression functions for each of the K clusters to estimate centers of motion for the data points;

calculating distances from each data point to each of the K regression functions;

calculating a membership probability for each data point based on distances between the K regression functions and each data point;

applying regression to recalculate the K regression functions based at least on the membership probabilities;

determining whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion;

repeating calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion; and

using motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion.

2. The program storage device of claim 1, wherein the performing regression clustering using the K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points further comprises providing motion vectors for the data points.

3. The program storage device of claim 1, wherein the performing regression clustering using the K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points further comprises providing at least one motion path for the data points.

5. The program storage device of claim 1, wherein the initializing regression functions for each of the K clusters further comprises randomly initializing regression functions for each of the K clusters.

7. The program storage device of claim 1, wherein the program instructions are executable to further calculate a weighting factor for each data point based on distances between the K regression functions and each data point, wherein the weighting factor is chosen to allow the K regression functions to be optimized with less sensitivity to initialization of the K regression functions.

8. The program storage device of claim 1 further comprising extracting data according to a predetermined criteria to provide the data points.

9. The program storage device of claim 8, wherein the extracting data according to the predetermined criteria comprises portioning data according to color.

10. The program storage device of claim 1, wherein the program instructions further include instructions for performing the operations comprising preparing each of the data points as x-y-coordinate data points.

11. The program storage device of claim 1, wherein the program instructions further include instructions for performing the operations comprising using the K regression functions to render the image sequence with motion paths shown on a display.

12. The program storage device of claim 11, wherein the using the K regression functions to render the image sequence further comprises overlaying the K regression functions on the video images to show motion between the video images.

13. A system for estimating motion trials in video image sequences, comprising:

an image sequence retrieval module for retrieving a current image and a first reference image and providing data points representing information from the current image and the first reference image; and

a motion estimator, coupled to the image sequence retrieval module, for performing regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points;

wherein the motion estimator performs regression clustering by selecting a number, K, of regression clusters for data points from an image sequence, initializing regression functions for each of the K clusters to estimate centers of motion for the data points, calculating distances from each data point to each of the K regression functions, calculating a membership probability for each data point based on distances between the K regression functions and each data point, applying regression to recalculate the K regression functions based at least on the membership probabilities, determining whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion, repeating calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion, and using motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion.

14. The system of claim 13, wherein the motion information regarding the data points further comprises motion vectors for the data points.

15. The system of claim 13, wherein the motion information regarding the data points further comprises at least one motion path for the data points.

17. The system of claim 13, wherein the motion estimator is to randomly initialize regression functions for each of the K clusters.

19. The system of claim 13, wherein the motion estimator is to further calculate a weighting factor for each data point based on distances between the K regression functions and each data point, wherein the weighting factor is chosen to allow the K regression functions to be optimized with less sensitivity to initialization of the K regression functions.

20. The system of claim 13, wherein the motion estimator is to extract data according to predetermined criteria.

21. The system of claim 20, wherein the motion estimator is to extract data according to color.

22. The system of claim 13, wherein the image sequence retrieval module is to prepare each of the data points as x-y-coordinate data points.

23. The system of claim 13 further comprising a processor for using the K regression functions to render the image sequence with motion paths shown on a display.

24. The system of claim 23, wherein the processor overlays the K regression functions on the video images to show motion between the current image and the first reference image.

25. A method for estimating motion trials in video image sequences, the method comprising:

providing data points representing information from an image sequence; and

performing, by a processor, regression clustering using a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points,

wherein the performing regression clustering comprises:

selecting a number, K, of regression clusters for data points from an image sequence;

initializing regression functions for each of the K clusters to estimate centers of motion for the data points;

calculating distances from each data point to each of the K regression functions;

calculating a membership probability for each data point based on distances between the K regression functions and each data point;

applying regression to recalculate the K regression functions based at least on the membership probabilities;

determining whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion;

repeating calculating the distances, calculating the membership probability, applying regression, and determining whether changes satisfy the stopping criterion if the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion; and

using motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion.

27. A system for estimating motion trials in video image sequences, comprising:

means for retrieving a current image and a first reference image and providing data points representing information from the current image and the first reference image; and

means for performing regression clustering, coupled to the means for retrieving and providing, wherein the means for performing regression clustering uses a K-Harmonic Means function to cluster the data points and to provide motion information regarding the data points,

wherein the means for performing regression clustering further comprises means for selecting a number, K, of regression clusters for data points from an image sequence, means for initializing regression functions for each of the K clusters to estimate centers of motion for the data points, means for calculating distances from each data point to each of the K regression functions, means for calculating a membership probability for each data point based on distances between the K regression functions and each data point, means for applying regression to recalculate the K regression functions based at least on the membership probabilities, determining whether changes in membership probabilities or changes in the K regression functions satisfy a stopping criterion, repeating calculating the distances, calculating the membership probability, applying regression, and determining whether the changes satisfy the stopping criterion if tasks of the changes in membership probabilities or changes in the K regression functions do not satisfy the stopping criterion, and means for using motion paths represented by the K regression functions if the changes in membership probabilities or changes in the K regression functions satisfy the stopping criterion.

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.